PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Report for
Anoka Ramsey Community College, Cambridge

Minnesota
STATE COLLEGES
& UNIVERSITIES

ANOKA-RAMSEY
COMMUNITY COLLEGE
CAMBRIDGE • COON RAPIDS

5/21/2012

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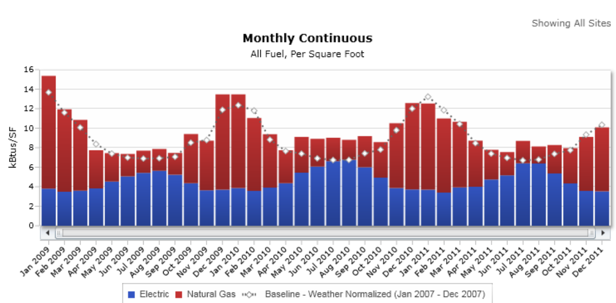
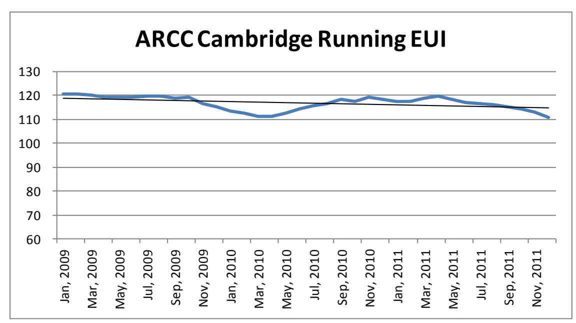
Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. A limited investigation of Anoka Ramsey Community College, Cambridge was performed by AMEC Earth and Environmental, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total Project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$27,678		Total Project Cost	$34,592
Future costs including Implementation , Measurement & Verification	$6,914		Study and Administrative Cost Paid with ARRA Funds	($29,678)
Total Project Cost	$34,592		Utility Rebates	($0)
			Total costs after co-funding	$4,914
Estimated Annual Total Savings ($)	$4,857		Estimated Annual Total Savings ($)	$4,857
Total Project Payback	7.1		Total Project Payback with co-funding	1.0
Electric Energy Savings	**6.0 %**	**and**	**Gas Energy Savings**	**3.2 %**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	112,856	13,007,837	12,211,613	796,224	7%	$214,953.20	$0.02
2010	365	112,856	13,352,997	11,904,968	1,448,029	12%	$237,275.79	$0.02
2011	365	112,856	12,471,391	12,035,102	436,289	4%	$228,131.91	$0.02

The energy use at Anoka Ramsey Community College, Cambridge decreased approximately 2% over the period of the investigation.

Summary Tables

Facility Name	Anoka Ramsey Community College, Cambridge
Location	300 Polk Street Cambridge, MN 55008
Facility Managers	Roger Freeman Jim Werronen
Number of Buildings Investigated	2
Interior Square Footage Investigated	95,000
PBEEEP Provider	AMEC Earth and Environmental, Inc.
Study Period	October 2011 through April 2012
Annual Energy Cost	$228,131 (2011)
Utility Company	East Central Energy (Electric) CenterPoint Energy (Gas)
Site Energy Use Index (EUI)	111 kBtu/ft^2 (end of screening) 109 kBtu/ft^2 (end of study
Benchmark EUI (from B3)	119 kBtu/ft^2

Building Data as listed in B3

Building Name	State ID	Area (Square Feet)	Year Built
Campus Center Addition 1	E26141C1107	41,000	2007
Campus Center	E26141C0596	54,000	1996

Mechanical Equipment Included in Investigation: Summary Table	
Total	**Equipment Description**
1	Andover Continuum Building Automation System
7	Air Handlers
112	VAV Boxes
2	Chillers
3	Boilers
3	Primary Hot Water Pumps
2	Secondary Hot Water Pumps
2	Chilled Water Pumps
2	Primary Chilled Water Pumps
2	Secondary Chilled Water Pumps

12	Exhaust Fans

Implementation Information			
Estimated Annual Total Savings ($)	5.1% Savings		$4,857
Total Estimated Implementation Cost ($)			$4,914
GHG Avoided in U.S Tons (CO2e)			69
Electric Energy Savings (kWh) (2011 Usage 1,802,612 kWh)	3.2 % Savings		55,922
Electric Demand Savings (kW) (2011 Peak Demand 720 kW)			0
Gas Energy Savings (Therms) (2011 Usage was 61,372 Therms)	6.0 % Savings		3,783
Statistics			
Number of Measures identified			9
Number of Measures with payback < 3 years			5
Screening Start Date	07/23/2010	Screening End Date	08/27/2010
Investigation Start Date	10/19/2011	Investigation End Date	3/27/2012
Final Report	5/21/2012		

Anoka Ramsey Community College, Cambridge Owatonna Cost Information			
Phase		**To date**	**Estimated Future Cost**
Screening		$2,240	
Investigation [Provider]		$24,990	
Investigation [CEE]		$448	$1,000
Implementation			$4,914
Implementation [CEE]			$500
Measurement & Verification			$500
Total		$27,678	$6,914

Co-funding Summary	
Study and Administrative Cost	$29,678
Utility Co-Funding - Estimated Total ($)	$0
Total Co-funding ($)	$29,678

Anoka Ramsey Community College, Cambridge Overview

The energy investigation identified 4.7 % of total energy savings at Anoka Ramsey Community College, Cambridge with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Anoka Ramsey Community College, Cambridge include optimizing economizer operations and adjusting equipment schedules to match actual occupancy periods in the building. The total cost of implementing all the measures is $4,914.

Implementing all these measures can save the facility approximately $4,857 a year. During the period of the PBEEEP investigation energy use at Anoka Ramsey Community College, Cambridge decreased approximately 2% compared to the year prior to the study. It is now 8% below the benchmark value according to the Minnesota Benchmarking and Beyond database.

ARCC Cambridge includes 9 buildings totaling 108,102 ft^2. There is a main campus structure with two floors totaling 95,000 ft^2 all of which is controlled by the building automation system and divided up into six different sections (1D, 1E, 1F, 2D, 2E, and 2F). The remaining buildings (garages, barns, and silo) are not on the automation system, contain no mechanical equipment and are used only for storage. All of the discussion below refers to the two main campus buildings.

Controls and Trending

The campus contains a Schneider Electric-IA ® automation system installed by UHL. The system controls all the major mechanical equipment in the main building campus. The system is capable of trending a large number of points.

General HVAC Overview

There are three boilers within the building. Boiler 1, which was installed in 2005 is the primary boiler and can meet the demand in the building except for on the coldest days of the year. Boiler 1 is also used in the summer for the reheats. Boilers 2 and 3 were installed in 1996 and are only used when boiler 1 cannot meet the demand in the space.

For cooling there are two air cooled chillers, one rated at 187 tons and the other rated at 353 tons. They utilize both variable primary pumping and variable secondary pumping.

The facility contains 7AHUs. Six of the AHUs contain VFDs. The other AHU serves laboratory space which requires constant exhaust so the AHU is constant volume. One of the AHU utilizes a heat exchanger for energy recovery due to the large amounts of OA it introduces to the space. Three of the AHUs were installed in 2005, 3 are from 1996, and the other one is from 2009.

Lighting

Most of the interior lighting consists of T8 28 watt lights. All classroom lights are controlled by occupancy sensors. The hallway lights are controlled by switches. Outside lights are controlled on the automation system and are high pressure sodium (HPS) lights. These lights can be replaced with 25 W bulbs as they burn out leading to additional energy savings.

Findings Summary

Site: ARCC Cambridge Campus

PBEEEP State Government

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
4	Campus Center Addition 1	OAD on AHU-F2 is open more then necessary during the heating season.	$546	$2,388	0.23	$0	0.23	18
3	Campus Center	Over scheduling AHU-E2.	$546	$984	0.56	$0	0.56	23
4	Campus Center	Simultaneous heating and cooling is present in AHU-E2.	$546	$400	1.37	$0	1.37	3
3	Campus Center Addition 1	OAD on AHU-F2 does not fully open when the unit goes into economizing mode.	$546	$357	1.53	$0	1.53	8
1	Campus Center Addition 1	OAD on AHU-F1 does not fully open when the unit goes into economizing mode.	$546	$283	1.93	$0	1.93	7
1	Campus Center	Over scheduling AHU-D1.	$546	$166	3.30	$0	3.30	4
5	Campus Center	Outdoor air damper control is not optimized for AHU-E3	$546	$125	4.36	$0	4.36	3
2	Campus Center	Economizer setpoint is not optimized for AHU-D1	$546	$109	5.01	$0	5.01	3
5	Campus Center Addition 1	Over scheduling AHU-F2.	$546	$45	12.01	$0	12.01	1
		Total for Findings with Payback 3 years or less:	**$2,730**	**$4,412**	**0.62**	**$0**	**0.62**	**59**
		Total for all Findings:	**$4,914**	**$4,857**	**1.01**	**$0**	**1.01**	**69**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Finding Type Number	Finding Type	Relevant Findings	Looked for, Not found	Not relevant
a.1 (1)	Time of Day enabling is excessive		2	
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	2		
a.3 (3)	Lighting is on more hours than necessary.		2	
a.4 (4)	OTHER_Equipment Scheduling/Enabling		2	
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not	2		
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design		2	
b.3 (7)	OTHER_Economizer/OA Loads		2	
c.1 (8)	Simultaneous Heating and Cooling is present and excessive	2		
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		2	
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints		2	
c.4 (11)	OTHER_Controls		2	
d.1 (12)	Daylighting controls or occupancy sensors need optimization.		2	
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.		2	
d.3 (14)	Fan Speed Doesn't Vary Sufficiently		2	
d.4 (15)	Pump Speed Doesn't Vary Sufficiently		2	
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary		2	
d.6 (17)	Other_Controls (Setpoint Changes)		2	

e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal		2	
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal		2	
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal		2	
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal		2	
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal		2	
e.6 (22)	Other_Controls (Reset Schedules)		2	
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit		2	
f.2 (24)	Pump Discharge Throttled		2	
f.3 (25)	Over-Pumping		2	
f.4 (26)	Equipment is oversized for load.		2	
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction		2	
g.1 (28)	VFD Retrofit - Fans		2	
g.2 (29)	VFD Retrofit - Pumps		2	
g.3 (30)	VFD Retrofit - Motors (process)		2	
g.4 (31)	OTHER_VFD		2	
h.1 (32)	Retrofit - Motors		2	
h.2 (33)	Retrofit - Chillers		2	
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)		2	
h.4 (35)	Retrofit - Boilers		2	
h.5 (36)	Retrofit - Packaged Gas fired heating		2	
h.6 (37)	Retrofit - Heat Pumps		2	

h.7 (38)	Retrofit - Equipment (custom)		2	
h.8 (39)	Retrofit - Pumping distribution method		2	
h.9 (40)	Retrofit - Energy/Heat Recovery		2	
h.10 (41)	Retrofit - System (custom)		2	
h.11 (42)	Retrofit - Efficient Lighting		2	
h.12 (43)	Retrofit - Building Envelope		2	
h.13 (44)	Retrofit - Alternative Energy		2	
h.14 (45)	OTHER_Retrofit		2	
i.1 (46)	Differed Maintenance from Recommended/Standard		2	
i.2 (47)	Impurity/Contamination		2	
i.3 ( )	Leaky/Stuck Damper		2	
i.4 ( )	Leaky/Stuck Valve		2	
i.5 (48)	OTHER_Maintenance		2	
j.1 (49)	OTHER		2	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Campus Center

Site: ARCC Cambridge Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	Over scheduling AHU-E2.	$546	$984	0.56	$0	0.56	23
4	Simultaneous heating and cooling is present in AHU-E2.	$546	$400	1.37	$0	1.37	3
1	Over scheduling AHU-D1.	$546	$166	3.30	$0	3.30	4
5	Outdoor air damper control is not optimized for AHU-E3	$546	$125	4.36	$0	4.36	3
2	Economizer setpoint is not optimized for AHU-D1	$546	$109	5.01	$0	5.01	3
	Total for Findings with Payback 3 years or less:	**$1,092**	**$1,383**	**0.79**	**$0**	**0.79**	**26**
	Total for all Findings:	**$2,730**	**$1,783**	**1.53**	**$0**	**1.53**	**35**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Campus Center

FWB Number:	13232	Eco Number:	1
Site:	ARCC Cambridge Campus	Date/Time Created:	5/8/2012

Investigation Finding:	Over scheduling AHU-D1.	Date Identified:	2/6/2012
Description of Finding:	AHU-D1 is scheduled to operate from 7:00AM to 10:00PM Monday through Friday and an additional 9 hours on Saturday. The space is only occupied from 8:00AM to 9:00PM Monday through Friday and 9 hours on Saturday. Warm up is not required because RAT remains constant at 70F throughout the night.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Staff interviews & trend data confirm hours of operation on the SF, RF and OA Damper position for AHU-D1. School hours were obtained through staff interviews.		
Measure:	Reschedule AHU-D1 to operate only during hours when the building is open or significantly staffed.		
Recommendation for Implementation:	Reprogram the SF and RF for AHU-D1 to start at 8:00AM and shut down at 9:00PM Monday through Friday, while maintaining 9 hours of operation on weekends. Reprogram the OAD to close during this time also to reduce air infiltration losses.		
Evidence of Implementation Method:	Trend the SF status, RF status, and OA damper position of AHU-D1 at 15 minute intervals for at least 2 weeks (during any outside conditions) to ensure the SF and RF shut down and the OA damper is closed when the space is unoccupied.		

Annual Electric Savings (kWh):	4,476	Contractor Cost ($):	$296
Estimated Annual kWh Savings ($):	$166	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$166	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.30	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.30	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.4%	Percent of Implementation Costs:	10.0%

Findings Details

Building: Campus Center

FWB Number:	13232	Eco Number:	2
Site:	ARCC Cambridge Campus	Date/Time Created:	5/8/2012

Investigation Finding:	Economizer setpoint is not optimized for AHU-D1	Date Identified:	2/6/2012
Description of Finding:	Trend data for AHU-D1 indicates the OA dampers switches to a minimum position of 5% open when the OA temperature reaches 60F. The most economical change point is 70F.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Trend data for AHU-D1 confirms the OAD changes to a minimum position of 5% open when the OA reaches 60F.		
Measure:	Reprogram AHU-D1 to stay in economizing mode until the OAT reaches 70F.		
Recommendation for Implementation:	Reprogram AHU-D1 to stay in economizing mode until the OAT reaches 70F.		
Evidence of Implementation Method:	Trend SF status, OAT, RAT, OAD and MAT at 15 minute intervals for at least two weeks in the spring (containing times when the OAT is greater than and less than 70F) to ensure AHU-D1 stays in economizing mode until the OAT reaches 70F.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	2,944 $109	Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$296 $250 $546

Estimated Annual Total Savings ($): Initial Simple Payback (years): Simple Payback w/ Utility Co-Funding (years): GHG Avoided in U.S. Tons (C02e):	$109 5.01 5.01 3	Utility Co-Funding for kWh ($): Utility Co-Funding for kW ($): Utility Co-Funding for therms ($): Utility Co-Funding - Estimated Total ($):	$0 $0 $0 $0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.2%	Percent of Implementation Costs:	10.0%

Findings Details

Building: Campus Center

FWB Number:	13232	Eco Number:	3
Site:	ARCC Cambridge Campus	Date/Time Created:	5/8/2012

Investigation Finding:	Over scheduling AHU-E2.	Date Identified:	2/6/2012
Description of Finding:	AHU-E2 is scheduled to operate from 5:00AM to 11:30PM Monday through Friday and an additional 9 hours on Saturday. The space is only occupied from 8:00AM to 9:00PM Monday through Friday and 9 hours on Saturday. Warm up is not required because RAT remains constant at 70F throughout the night.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Staff interviews & trend data confirm hours of operation on the SF, RF and OA Damper position for AHU-E2. School hours were obtained through staff interviews.		
Measure:	Reschedule AHU-E2 to operate only during hours when the building is open or significantly staffed.		
Recommendation for Implementation:	Reprogram the SF and RF AHU-E2 to start at 8:00AM and shut down at 9:00PM Monday through Friday, while maintaining 9 hours of operation on weekends. Reprogram the OAD to close during this time also to reduce air infiltration losses.		
Evidence of Implementation Method:	Trend the SF status, RF status, and OA damper position of AHU-D1 at 15 minute intervals for at least 2 weeks (during any outside conditions) to ensure the SF and RF shut down and the OA damper is closed when the space is unoccupied.		

Annual Electric Savings (kWh):	26,581	Contractor Cost ($):	$296
Estimated Annual kWh Savings ($):	$984	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$984	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.56	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.56	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	23	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	20.1%	Percent of Implementation Costs:	10.0%

Findings Details

Building: Campus Center

FWB Number:	13232	Eco Number:	4
Site:	ARCC Cambridge Campus	Date/Time Created:	5/8/2012

Investigation Finding:	Simultaneous heating and cooling is present in AHU-E2.	Date Identified:	2/3/2012
Description of Finding:	The MAT for AHU-E2 is set to 55F and is controlled by opening and closing the OAD in the winter, while the DAT is set to 62F. The MAT should be set to 2degF less than the DAT to reduce the amount of heating that is required.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls Problems
Finding Type:	Simultaneous Heating and Cooling is present and excessive		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Trend data for AHU-E2 confirms the MAT, OAT, OA Damper position and DAT vs. Time.		
Measure:	Reprogram the MAT for AHU-E2 to 2F lower than the DAT setpoint.		
Recommendation for Implementation:	Reprogram the MAT for AHU-E2 to 2F lower than the DAT setpoint while maintaining minimum OA% for air quality concerns.		
Evidence of Implementation Method:	Trend the SF status, OAT, OA damper position, MAT, and RAT of AHU-E2 at 15 minute intervals for at least two weeks to ensure the MAT is maintained at 2F below the DAT setpoint. Analyze the trend data to ensure the minimum %OA is maintained.		

Annual Natural Gas Savings (therms):	542	Contractor Cost ($):	$296
Estimated Annual Natural Gas Savings ($):	$400	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$400	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.37	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.37	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	8.2%	Percent of Implementation Costs:	10.0%

Findings Details

Building: Campus Center

FWB Number:	13232	Eco Number:	5
Site:	ARCC Cambridge Campus	Date/Time Created:	5/8/2012

Investigation Finding:	Outdoor air damper control is not optimized for AHU-E3	Date Identified:	2/3/2012
Description of Finding:	OA damper moves to minimum position (15) whenever the CHW valve opens and the damper never closes. When CHW valve closes, OA damper opens to 100%.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls contractor.	Benefits:	Energy Reduction. Improved IAQ during free cooling.
Baseline Documentation Method:	Trend data for AHU-E3 monitors MAT, OAT, OA damper position, space temperature, but no RAT. %OA is determined from space temperature.		
Measure:	Adjust OA damper to maintain minimum MAT and IAQ. OA damper never closes since there are fumes requiring exhaust 24/7.		
Recommendation for Implementation:	Adjust the control sequences to have the cooling coil, heating coil, and outside air damper modulate in sequence to meet the discharge air temperature setpoint. For simplicity, the mixed air temperature setpoint can be set to the DAT minus 2F. The minimum outside damper position of 15% shall remain in place to ensure adequate ventilation. Remove the lockout that currently exists between the chilled water valve and the outside air damper.		
Evidence of Implementation Method:	Trend the supply fan status, DAT, DAT setpoint, MAT, HW valve position, CHW valve position, and OA damper at 15 minute intervals for at least 2 weeks when 30<70F. Analyze the trend data to ensure that AHU-E3 economizes to meet the DAT setpoint when outside conditions are appropriate and that the OA damper goes to minimum position and the CHW valve is closed when the heating valve is open.		

Annual Electric Savings (kWh):	3,388	Contractor Cost ($):	$296
Estimated Annual kWh Savings ($):	$125	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$125	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.36	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.36	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.6%	Percent of Implementation Costs:	10.0%

Findings Summary

Building: Campus Center Addition 1
Site: ARCC Cambridge Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
4	OAD on AHU-F2 is open more then necessary during the heating season.	$546	$2,388	0.23	$0	0.23	18
3	OAD on AHU-F2 does not fully open when the unit goes into economizing mode.	$546	$357	1.53	$0	1.53	8
1	OAD on AHU-F1 does not fully open when the unit goes into economizing mode.	$546	$283	1.93	$0	1.93	7
5	Over scheduling AHU-F2.	$546	$45	12.01	$0	12.01	1
	Total for Findings with Payback 3 years or less:	**$1,638**	**$3,029**	**0.54**	**$0**	**0.54**	**33**
	Total for all Findings:	**$2,184**	**$3,074**	**0.71**	**$0**	**0.71**	**34**

Findings Details

Building: Campus Center Addition 1

FWB Number:	13231	Eco Number:	1
Site:	ARCC Cambridge Campus	Date/Time Created:	5/9/2012

Investigation Finding:	OAD on AHU-F1 does not fully open when the unit goes into economizing mode.	Date Identified:	2/8/2012
Description of Finding:	During economizing the OAD does not fully open resulting in the MAT to be higher then needed, creating extra added cooling to the system.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls contractor.	Benefits:	Energy Reduction.
Baseline Documentation Method:	Trends of the OAD position vs OAT were observed to be sub optimal between the temperatures of 52F and 70F. Trends of the OAT, RAT and MAT were used to calculate the %OA that was coming into the system to verify damper position was not open all the way.		
Measure:	Reprogram the OAD on AHU-F1 to fully open and allow 100% OA into the system during economizing mode.		
Recommendation for Implementation:	Reprogram the OAD for AHU-F1 to fully open and allow 100% OA into the system during the economizing mode. The unit shall modulate the OA dampers to maintain a MAT setpoint, which is equal to the DAT setpoint minus 2F, without ever going below the minimum OA damper position setpoint. An economizer lockout shall be put in place so that the OA dampers go to minimum position once the OAT is 70F or higher.		
Evidence of Implementation Method:	Trend the OA damper position, SF status, MAT, OAT and RAT at 15 minute intervals for at least two weeks when the OAT is greater than 40F and less than 70F. Analyze trend data to ensure that 100% OA is allowed into the system during economizer mode.		

Annual Electric Savings (kWh):	7,661	Contractor Cost ($):	$296
Estimated Annual kWh Savings ($):	$283	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$283	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.93	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.93	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	7	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	5.8%	Percent of Implementation Costs:	10.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Campus Center Addition 1

FWB Number:	13231	Eco Number:	3
Site:	ARCC Cambridge Campus	Date/Time Created:	5/9/2012

Investigation Finding:	OAD on AHU-F2 does not fully open when the unit goes into economizing mode.	Date Identified:	2/8/2012
Description of Finding:	During economizing the OAD does not fully open resulting in the MAT to be higher then needed, creating extra added cooling to the system.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls contractor.	Benefits:	Energy Reduction.
Baseline Documentation Method:	Trends of the OAD position vs OAT were observed to be sub optimal between the temperatures of 60F and 70F. Trends of the OAT, RAT and MAT were used to calculate the %OA that was coming into the system to verify damper position was not open all the way.		
Measure:	Reprogram the OAD on AHU-F2 to fully open and allow 100% OA into the system during economizing mode.		
Recommendation for Implementation:	Reprogram the OAD for AHU-F1 to fully open and allow 100% OA into the system during the economizing mode. The unit shall modulate the OA dampers to maintain a MAT setpoint, which is equal to the DAT setpoint minus 2F, without ever going below the minimum OA damper position setpoint. An economizer lockout shall be put in place so that the OA dampers go to minimum position once the OAT is 70F or higher.		
Evidence of Implementation Method:	Trend the OA damper position, SF status, MAT, OAT and RAT at 15 minute intervals for at least two weeks when the OAT is greater than 40F and less than 70F. Analyze trend data to ensure that 100% OA is allowed into the system during economizer mode.		

Annual Electric Savings (kWh):	9,643	Contractor Cost ($):	$296
Estimated Annual kWh Savings ($):	$357	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$357	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.53	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.53	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	8	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	7.3%	Percent of Implementation Costs:	10.0%

Findings Details

Building: Campus Center Addition 1

FWB Number:	13231	Eco Number:	4
Site:	ARCC Cambridge Campus	Date/Time Created:	5/9/2012

Investigation Finding:	OAD on AHU-F2 is open more then necessary during the heating season.	Date Identified:	2/8/2012
Description of Finding:	The OAD on AHU-F2 is open more then necessary during the heating season. This makes the MAT lower then what is needed creating extra heating on the system.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls Problems
Finding Type:	Simultaneous Heating and Cooling is present and excessive		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Trends of the OAD position vs OAT show that for low temperatures the OAD does not close. Trends of the OAT, MAT and RAT were used to calculate the %OA being drawn into the system.		
Measure:	Reprogram the OAD on AHU-F2 to maintain a minimum position that allows the MAT to be set to 60F.		
Recommendation for Implementation:	Reprogram the OAD for AHU-F2 during the heating season to maintain a minimum position that allows the MAT to be set to 60F.		
Evidence of Implementation Method:	Trend the OA Damper vs OAT to ensure the Damper is closing as the temperature decreases. Trend OAT, MAT and RAT to calculate the %OA and ensure it is at a minimum value while the MAT remains constant at 60F.		

Annual Natural Gas Savings (therms):	3,241	Contractor Cost ($):	$296
Estimated Annual Natural Gas Savings ($):	$2,388	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$2,388	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.23	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.23	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	18	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	48.9%	Percent of Implementation Costs:	10.0%

Findings Details

Building: Campus Center Addition 1

FWB Number:	13231	Eco Number:	5
Site:	ARCC Cambridge Campus	Date/Time Created:	5/9/2012

Investigation Finding:	Over scheduling AHU-F2.	Date Identified:	2/8/2012
Description of Finding:	AHU-F2 is scheduled to operate from 7:00AM to 4:00PM on Saturday. The space is only occupied from 8:00AM to 3:00PM on Saturday. Warm up is not required because RAT remains constant at 70F throughout the night.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Staff interviews & trend data confirm hours of operation on the SF, RF and OA Damper position for AHU-F2. School hours were obtained through staff interviews.		
Measure:	Reschedule AHU-F2 to operate only during hours when the building is open or significantly staffed.		
Recommendation for Implementation:	Reprogram the SF and RF for AHU-F2 to start at 8:00AM and shut down at 3:00PM on Saturdays. Reprogram the OAD to close during this time also to reduce air infiltration losses.		
Evidence of Implementation Method:	Trend AHU-F2 SF status, RF status, and OA damper position at 15 minute intervals for two weeks (during any outside conditions) to ensure the AHU operates according to the revised schedule and the OA damper is closed when the unit is off.		

Annual Electric Savings (kWh):	1,229	Contractor Cost ($):	$296
Estimated Annual kWh Savings ($):	$45	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$546

Estimated Annual Total Savings ($):	$45	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.01	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.01	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.9%	Percent of Implementation Costs:	10.0%

800 Marquette Avenue S
Minneapolis, MN 55402
612-332-8326

Owner	Anoka Ramsey Community College
Location	Cambridge, MN
Project	PBEEEP Retro-commissioning
Building	

No.	Date Found	System	Issue	Date Resolved	Solution
1	2/6/2012	D1	Trend data indicates that this system operates 89 hours per week. Since classes do not start until 8 AM and very few run past 9 PM, Operation could be reduced to 79 hours per week.		Reschedule AHU operation to start at 7 AM and shut off at 9 PM Mon.-Fri., while maintaining 9 hours on Saturday.
2	2/6/2012	D1	Trend data indicates an economizer switch to minimum OA at 60º OA temperature. The most economical change point is 70 to 71º.		Set economizer changeover to 71º F.
3	2/6/2012	E2	Trend data indicates that this system operates 101.5 hours per week. Since classes do not start until 8 AM and very few run past 9 PM, Operation could be reduced to 79 hours per week.		Reschedule AHU operation to start at 7 AM and shut off at 9 PM Mon.-Fri., while maintaining 9 hours on Saturday.
4	2/3//2012	E2	No data from 5/31/2011 to 6/20/2011		
5	2/3//2012	E2	RAT, MAT & DAT missing before 3/19		
6	2/3//2012	E2	SF starts at 5 AM with RA at 70º. Warm up is not required.		Delay system start time

No.	Date Found	System	Issue	Date Resolved	Solution
7	2/3//2012	E2	MAT is maintained at 55 with OA, while the DAT is maintained at 62 using heating water MAT should be maintained at about 2º.less than the DAT. DAT should set low enough to maintain the warmest zone at or below the cooling setpoint.		
8	2/3//2012	E2	Unit operates 5 AM until 11:30 PM on weekdays. Verify that this schedule is required. Warm-up is not necessary at the observed heating conditions.		
9	2/3//2012	E2	Trends indicate OA dampers modulate to maintain MA setpoint when the fan starts. If a warm-up or optimal start cycle is required, the OA dampers should be closed prior to building occupancy.		
10	2/3//2012	E2	Heating valve is open on night cycle when the OA temp is over 50. This should be adjusted to close if OAT is over 40ºF.		
11	2/3//2012	E3	AHU runs 24/7		
12	2/3//2012	E3	OA damper moves to minimum position (15) whenever CHW valve opens.		
13	2/3//2012	E3	When CHW valve closes, OA damper opens to 100%		
14	2/3//2012	E3	OA damper never closes		
15	2/3//2012	E3	Heating valve data is generally missing.		

No.	Date Found	System	Issue	Date Resolved	Solution
16	2/3//2012	E3	Heating valve appears to be stuck open as air is unnecessarily heated from MAT to DAT. DAT found to exceed setpoint by 10ºF.		
17	2/3//2012	E3	RA temp data missing		
18	2/3//2012	E3	MAT exceeds OAT when OA damper is indicated at 100% open. RA damper may be leaking.		
19	2/6/12	E4	The HWR temperature is consistently higher than the HWS. Data is either mislabeled or at least one of the sensors requires calibration or replacement.		
20	2/7/12	E4	The Heating Valve is at 100% whenever there is a data reading. The data is either bad, the valve doesn't work or it is manually controlled.		
21	2/7/12	E4	RA humidity often exceeds 60%. The sensor is probably out of calibration.		Recalibrate the humidity sensor
22	2/7/12	E4	At noon on, Monday 7/25, CHW Return tem exceeds both the space temperature and OA. This is not possible and indicates a sensor problem.		
23	2/7/12	E4	SA flow is frequently 40% less than OA flow. Some OA would normally be diverted to the exhaust stream to limit contamination of the OA, but this would be more like 5%. One or more AFMSs are out of calibration.		

No.	Date Found	System	Issue	Date Resolved	Solution
24	2/7/12	E4	Building staff reported that the heat exchanger is not used. The trend data indicates that it 100% on at all times.		
25	2/7/12	E4	The return static fluctuates between -1” and -2.7”.		
26	2/8/12	F1	During cool weather, the OA damper is at 100%, the temperature calculated OA flow is about 70% and the measured OA flow averages about 3500 CFM. Demand controlled ventilation may be able to reduce the associated cost of ventilation.		
27	2/8/12	F1	The OA damper does not fully open when economizer operations are applicable.		
28	2/8/12	F1	Reduce Saturday operating schedule to match occupancy.		
29	2/7/12	F2	Heating Valve trend data is often missing.		
30	2/7/12	F2	The heating season OA damper position is 100 by day and 0 at night.		
31	2/7/12	F2	The cooling season OA damper position is 34 to 100 by day and 0 at night.		
32	2/7/12	F2	There is too much missing data to fully understand system operation and develop conservation measures.		
33	2/7/12	F2	Reduce Saturday operating schedule to match occupancy.		

No.	Date Found	System	Issue	Date Resolved	Solution
34	1/30/2012	G-3	The CO2 limit appears to be set at 700 PPM. This leads to generous amounts of outside air introduced into the building with excessive heating and cooling costs.		Increase set point to 1000 PPM
35	1/30/2012	G-3	RMG202 CO2 sensor readings were less than the world ambient level of 400 PPM. The sensor is out of calibration.		Repair, replace or recalibrate this CO2 sensor.
36	2/7/12	E4	The return static fluctuates between -1" and -2.7".		
37	1/30/2012	G-3	The heating valve indicates a closed position at night, but the MAT rises, indicating heating.		
38	2/6/2012	G-3	On a warm day (6/30/11), the OA damper position fluctuates between 50 and 0%. There is no obvious logic to the OA or relief damper positions.		
39	2/6/2012	G-3	The relief damper position does not correspond with the OA damper position. It is frequently 80% open when the OA damper is closed.		
40	2/6/2012	G-3	On a warm day (6/30/11), the DAT was at 67º with RAT exceeding 80º. The OAT was over 90º, OA closed and the chiller on.		

No.	Date Found	System	Issue	Date Resolved	Solution
41	2/6/2012	G-3	There seems to be a malfunction with the chilled water coil. The DAT setpoint is 47 (7/5/11), but the DAT averages about 68. There is an approximate 12º ΔT across the cooling coil, indicating that there is some CHW flow. Chiller data is unavailable. The CHW valve indicates 100% open. CHW flow is either insufficient or the CHS is not cold enough.		Check strainers and CHW valve operation.
42	2/6/2012	G-3	Space static pressure varies from +0.1 to -0.1”. There is little correlation with OA or relief damper positions. It seems that the pressure in this area is strongly influenced by other systems.		

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P13232 - ARCC/Campus Center Addition 1

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	AHU-D1, AHU-E2		Units operate more hours then necessary.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU-D1, AHU-E3		Economizer setpoint is not optimized.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X	AHU-E2		MAT is set to low creating excessive heating.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls			Investigation looked for, but did not find this issue.	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Investigation looked for, but did not find this issue.	
	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P13232 - ARCC/Campus Center Addition 1

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	**g.2 (29)**	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
	g.4 (31)	OTHER_VFD			Investigation looked for, but did not find this issue.	
h. Retrofits:	**h.1 (32)**	Retrofit - Motors			Investigation looked for, but did not find this issue.	
	h.2 (33)	Retrofit - Chillers			Investigation looked for, but did not find this issue.	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Investigation looked for, but did not find this issue.	
	h.4 (35)	Retrofit - Boilers			Investigation looked for, but did not find this issue.	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Investigation looked for, but did not find this issue.	
	h.6 (37)	Retrofit - Heat Pumps			Investigation looked for, but did not find this issue.	
	h.7 (38)	Retrofit - Equipment (custom)			Investigation looked for, but did not find this issue.	
	h.8 (39)	Retrofit - Pumping distribution method			Investigation looked for, but did not find this issue.	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Investigation looked for, but did not find this issue.	
	h.10 (41)	Retrofit - System (custom)			Investigation looked for, but did not find this issue.	
	h.11 (42)	Retrofit - Efficient Lighting			Investigation looked for, but did not find this issue.	
	h.12 (43)	Retrofit - Building Envelope			Investigation looked for, but did not find this issue.	
	h.13 (44)	Retrofit - Alternative Energy			Investigation looked for, but did not find this issue.	
	h.14 (45)	OTHER_Retrofit			Investigation looked for, but did not find this issue.	
i. Maintenance Related Problems:	**i.1 (46)**	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance			Investigation looked for, but did not find this issue.	
j. OTHER	**j.1 (49)**	OTHER			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P13231 - ARCC/Campus Center Addition 1

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	AHU-F1, AHU-F2		Units operate more hours then necessary.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU-F1, AHU-F2		OAD do not fully open during economizer mode.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X	AHU-F2		OAD is open more then necessary during the heating season.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls			Investigation looked for, but did not find this issue.	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Investigation looked for, but did not find this issue.	
	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P13231 - ARCC/Campus Center Addition 1

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
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	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
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h. Retrofits:	h.1 (32)	Retrofit - Motors			Investigation looked for, but did not find this issue.	
	h.2 (33)	Retrofit - Chillers			Investigation looked for, but did not find this issue.	
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	h.14 (45)	OTHER_Retrofit			Investigation looked for, but did not find this issue.	
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	i.5 (48)	OTHER_Maintenance			Investigation looked for, but did not find this issue.	
j. OTHER	j.1 (49)	OTHER			Investigation looked for, but did not find this issue.	

Deleted Findings Summary

Building: Campus Center Addition 1
Site: ARCC Cambridge Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over scheduling AHU-F1: payback > 15 yrs	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Campus Center Addition 1

FWB Number:	13231	Eco Number:	2
Site:	ARCC Cambridge Campus	Date/Time Created:	5/20/2012

Investigation Finding:	Over scheduling AHU-F1: payback > 15 yrs	Date Identified:	2/8/2012
Description of Finding:	AHU-F1 is scheduled to operate from 7:00AM to 4:00PM on Saturday. The space is only occupied from 8:00AM to 3:00PM on Saturday. Warm up is not required because RAT remains constant at 70F throughout the night. AMEC estimated that this measure would save 1,208 kWh and 78 Therms annually and cost $496 to implement. However, corrections made to the calculations during the review process reduced the savings. As a result, the payback exceeded 15 years and this measure was deleted.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor.	Benefits:	Energy reduction
Baseline Documentation Method:	Staff interviews & trend data confirm hours of operation on the SF, RF and OA Damper position for AHU-F1. School hours were obtained through staff interviews.		
Measure:	Reschedule AHU-F1 to operate only during hours when the building is open or significantly staffed.		
Recommendation for Implementation:	Reprogram the SF and RF for AHU-F1 to start at 8:00AM and shut down at 3:00PM on Saturdays. Reprogram the OAD to close during this time.		
Evidence of Implementation Method:	Trend AHU-F1 SF status, RF status, and OA damper position at 15 minute intervals for two weeks (during any outside conditions) to ensure the AHU operates according to the revised schedule and the OA damper is closed when the unit is off.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR ANOKA-RAMSEY COMMUNTIY COLLEGE CAMBRIDGE

Date: 8/23/2010

Summary Table

Facility Name	**Anoka Ramsey Community College**
Location	300 Polk Street Cambridge, MN 55008
Facility Manager	Roger Freeman
Number of Buildings	9
Interior Square Footage	108,102
PBEEEP Provider	CEE (Neal Ray)
State's Project Manager	Mike Seymour
Date Visited	8/19/2010
Annual Energy Cost	$213,941.59 (From 2009 B3 Data)
Utility Company	East Central Energy (Electric) CenterPoint Energy (Gas)
Site Energy Use Index (EUI)	110.6 kBtu/ft^2
Benchmark EUI (form B3)	118.6 kBtu/ft^2

Recommendation for Investigation

Anoka Ramsey Community College (ARCC) Cambridge consists of 9 buildings (refer to the *Campus Map* at the end of report. There are a total of 2 buildings which compromise the main campus totaling 95,000 ft^2 which will be recommended for investigation. There are 7 other buildings not attached to the main campus including three garages, a silo, two barns, and a building scheduled to be demolished which will not be investigated. These buildings total 13,102 ft^2.

Table 1: Building Data as listed in B3

Building Name	State ID	Area (Square Feet)	Year Built	Recommended for Investigation
Campus Center Addition 1	E26141C1107	41,000	2007	Y
Campus Center	E26141C0596	54,000	1996	Y
Silo	E26141C1005	200	2005	N
Pole Barn	E26141C0805	1,500	2005	N
Humanities Addition #2	E26141C0693	5,950	1993	N
Garage	E26141C0905	720	2005	N
Garage	E26141C0386	832	1986	N
Campus Center Garage	E26141C0305	2,400	2005	N
Barn	E26141C0705	1,500	2005	N

Anoka Ramsey Community College Cambridge Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of ARCC Cambridge was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. This report is the result of that information.

ARCC Cambridge includes 9 buildings totaling 108,102ft^2. There is a main campus structure with two floors totaling 95,000 ft^2 all of which is controlled by the building automation system and divided up into six different sections (1D, 1E, 1F, 2D, 2E, and 2F). The garages, barns, and silo are not on the automation system and contain no mechanical equipment and are used only for storage.

Controls and Trending
The campus contains a Schneider Electric-IA ® automation system installed by UHL. The system controls all the major mechanical equipment in the main building campus. The system is capable of trending a large number of points. The screening report below lists the points within each building the system controls.

General HVAC Overview
There are three boilers within the building. Boiler 1, which was installed in 2005 is the primary boiler and can meet the demand in the building except for on the coldest days of the year. Boiler 1 is also used in the summer for the reheats. Boiler 2 and 3 were installed in 1996 and are only used when boiler 1 cannot meet the demand in the space.

For cooling there are two air cooled chillers, one rated at 187 tons and the other rated at 353 tons. They utilize both variable primary pumping and variable secondary pumping.

The facility contains 7AHUs. Six of the AHUs contain VFDs. The other AHU serves lab space which requires constant exhaust so the AHU is constant volume. One of the AHU utilizes a heat exchanger for energy recovery due to the large amounts of OA it introduces to the space. Three of the AHUs were installed in 2005, 3 are from 1996, and the other one is from 2009.

Lighting
Most of the interior lighting consists of T8 28 watt lights. All classroom lights are controlled by occupancy sensors. The hallway lights are controlled by switches. Outside lights are controlled on the automation system and are high pressure sodium (HPS) lights.

EUI B3 Benchmark Overview
The actual energy user index (EUI), as computed from utility bills and square footage, is currently at 110.6 kBtu/ft^2, which is slightly lower than the B3 benchmark score of 118.6 kBtu/ft^2. On average the state median scores are 23% lower than their corresponding B3 Benchmarks. This shows that ARCC Cambridge may be a good candidate for an investigation.

Metering
There are a total of three gas meters and three electrical meters on the campus. One electrical and one gas meter are scheduled to be decommissioned once the building they serve is demolished.

Documentation
There is a large amount of building documentation available. There are mechanical plans for all renovations done, a commissioning and balancing report from the 2005 addition, and control sequences for the 2005 addition. Operation and maintenance manuals are available for all mechanical equipment.

Building Naming Characteristics
Currently there are 10 buildings with state ID's within B3. One of the buildings, Humanities Addition #1 has been demolished. It was stated Humanities Addition #2 is scheduled to be demolished as well. B3 data should be updated to reflect this.

Mechanical Equipment Summary Table	
1	Building Automation System
108,102	Square Feet
7	Air Handlers
112	VAV Boxes
2	Chillers
3	Boilers
3	Primary Hot Water Pumps
2	Secondary Hot Water Pumps
2	Chilled Water Pumps
2	Primary Chilled Water Pumps
2	Secondary Chilled Water Pumps
12	Exhaust Fans

PBEEEP Screening Report for Anoka Ramsey Community College Coon Rapids PBEEEP # P13100

This screening report is based on the PBEEEP Guidelines. It is based on one site visit, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate or inclusive.

Good Candidates for Investigation

The two ARCC Cambridge buildings below are good candidates for investigation. They have a large square footage, at least one central air handling unit, are tied into the automation system; and only one building has been commissioned.

Potential Energy Savings Opportunities:

- Non-school mode operation
- Improved operation of chilled water pumps
- Potential to reduce simultaneous heating and cooling
- Assure sensors are calibrated properly
- Assure proper operation of economizer dampers

Anoka Ramsey Community College Cambridge Main Campus					
Campus Center Addition 1 **Campus Center**			State ID# E26141C1107 State ID# E26141C0596		
Area (sqft)	95,000	Year Built	1996, 2007	Occupancy (hrs/yr)	4,300
HVAC Equipment					

Description	**Type**	**Size**	**Notes**
AHU-F1	Variable air volume	11,075 CFM 15 HP SF 7.5 HP RF	Installed in 2005
AHU-F2	Variable air volume	21,300 CFM 25 HP SF 15 HP RF	Installed in 2005
AHU-G3	Variable air volume	5,980 CFM 10 HP SF 5 HP RF	Installed in 2005
AHU-D1	Variable air volume	22,000 CFM 30 HP SF Unknown RF HP	Installed in 1996
AHU-E2	Variable air volume	27,500 CFM 40 HP SF Unknown RF HP	Installed in 1996
AHU-E3	Constant Volume	5,500 CFM 7.5 HP SF	Installed in 1996
AHU-E4	Variable air volume	10,275 CFM 20 HP SF 120 HP EF	Installed in 2009
Boiler 1	Aerco Benchmark	2580 MBH	Installed in 2005. This boiler is used for summer reheat and during the winter. Can meet the demand in the building except for the coldest days of the year.
Boiler 2	Kewanee	1750 MBH Rating	Installed in 1996
Boiler 3	Kewanee	1750 MBH Rating	Installed in 1996
Chiller-1	Trane	187 tons	Installed in 2005
Chiller-2	Trane	353 tons	Installed in 2005
Pump 1	TACO F14009	15 HP 800 gpm	Primary chilled water pump with VFD, installed 2005
Pump 2	TACO F14009	15 HP 800 gpm	Primary chilled water pump with VFD, installed 2005
Pump 3	TACO F14011	40 HP 800 gpm	Secondary chilled water pump with VFD, installed 2005

Building Equipment (continued)			
Description	**Type**	**Size**	**Notes**
Pump 4	TACO F14011	40 HP 800 gpm	Secondary chilled water pump with VFD, installed 2005
Pump 5	TACO KV3007	3 HP 170 gpm	Primary hot water pump, constant volume with 2 way valve, installed 2005
Pump 6	TACO KV3007	3 HP 170 gpm	Primary hot water pump, constant volume with 3 way valve, installed 2005
Pump 7	TACO KV3007	5 HP 275 gpm	Primary hot water pump, constant volume with 3 way valve, installed 2005
Pump 8	TACO F14011	40 HP 770 gpm	Secondary hot water pump, VFD, installed 2005
Pump 9	TACO F14011	40 HP 770 gpm	Secondary hot water pump, VFD, installed 2005
12 Exhaust Fans		265 to 1,400 CFM	Installed 2005
EAV-1 through EAV-13	Lab airflow venturi	365 to 2430 CFM	Installed in 2009
SAV-1 through SAV-4	Lab airflow venturi	515 to 3715 CFM	Installed in 2009

Points on BAS	
Description	**Points**
AHU-D1 AHU-E2	OA damper, MAT, CHW valve%, Face bypass damper %, HW valve %, SF command, SF speed, DAT, Duct static, RARH, RAT, RF command, RF speed, DAT setpoint, MAT offset setpoint, Unocc MAT setpoint, Duct static setpoint, AM warm-up setpoint, Heat valve lockout temp, Min OA damper %, Heat mode face bypass damper setpoint, RARH dehumidify setpoint, Dehumidify mode DAT setpoint
AHU-E3	OA dampers, MAT, Face bypass damper %, HW valve %, CHW valve %, SF command, DAT, DAT setpoint, MAT offset setpoint, Unocc MAT setpoint, Heat valve lockout temp, Heat mode face bypass damper setpoint, Min OA damper %
AHU-E4	OA damper %, OA CFM, OAT, HX supply temp, MAT, HW valve %, CHW valve %, SF command, SF speed, DAT, DAT setpoint, Duct static, Return static, RAT, RARH, RA CFM, Mixing damper %, HX exhaust temp, EF command, EF speed, EA damper, MAT low limit setpoint, Unocc MAT setpoint, Duct static low limit setpoint, Occ return static setpoint, Unocc return static setpoint, HW valve lockout setpoint, CHW valve lockout setpoint, Average space temp, Total delta temp, HW supply temp, HW return temp, CHW supply temp, CHW return temp, OA enthalpy, RA enthalpy
AHU-F1 AHU-F2	OA damper%,, OA CFM, MAT, CHW valve%, Face bypass damper %, HW valve%, SF command, SF speed, Duct static, DAT, Max VAV damper position, Average space temp, Space static, RA CFM, RARH, RAT, RF command, RF speed, Relief damper %, Relief CFM, Roof damper command, DAT setpoint, MAT offset setpoint, Unocc MAT setpoint, Duct static setpoint, Space pressure setpoint, Heat valve lockout temp, Heat mode face bypass damper setpoint, Min OA CFM setpoint, RARH dehumidify setpoint, Dehumidify mode DAT setpoint
AHU-G3	OA damper %, OA CFM, MAT, Heating coli face bypass damper %, HW valve %, Cooling coil face bypass damper %, CHW valve %, SF command, SF speed, DAT, Duct static pressure, Supply CFM, Space static, RA CFM, RAT, RARH, RF command, RF speed, Relief dampers %, Relief air CFM, Room G201 CO2, Room G202 CO2, Average space temperature, Low capacity mode, DAT setpoint, MAT offset, setpoint, Unocc MAT setpoint, Duct static setpoint, Space pressure setpoint, Cooling damper setpoint, HW valve lockout temperature, Heat mode face bypass damper setpoint, Min. OA CFM setpoint, RARH dehumidify setpoint, Space CO2 setpoint, Dehumidify mode DAT setpoint, Roof damper command
Boiler	Boiler command, Boiler status, Boiler 1 firing rate, Boiler primary HWST, Primary pump command, Primary bypass valve %, Secondary pump command, Secondary pump speed, Secondary HWST, Secondary HWRT, Differential pressure, Differential pressure setpoint, Boiler enable setpoint, HWS reset setpoint, Back up boiler setpoint
Chiller	Chiller enable setpoint, Differential pressure setpoint, CHWST setpoint, Chiller valve position, Primary pump command, Primary pump speed, Primary CHWST, Primary CHWRT, Secondary pump command, Secondary pump speed, Secondary CHWST, Secondary CHWRT, Differential pressure, Differential pressure setpoint

Points on BAS (continued)

Description	Points
VAV	Damper %, Reheat valve %, Flow, Flow setpoint, Space temperature, Space temperature setpoint, Radiation valve, AHU supply temperature
Exhaust Fan	EF command, Room temperature, Room temperature setpoint
Science Exhaust Control	Exhaust flow, Jam alarm, Face velocity, Sash position, Total supply flow, Total exhaust flow, Space temperature, Space temperature setpoint, HW valve %
Lighting	Outside lumen level, Lumen setpoint, Lighting status, Lighting overrides

Additional Comments

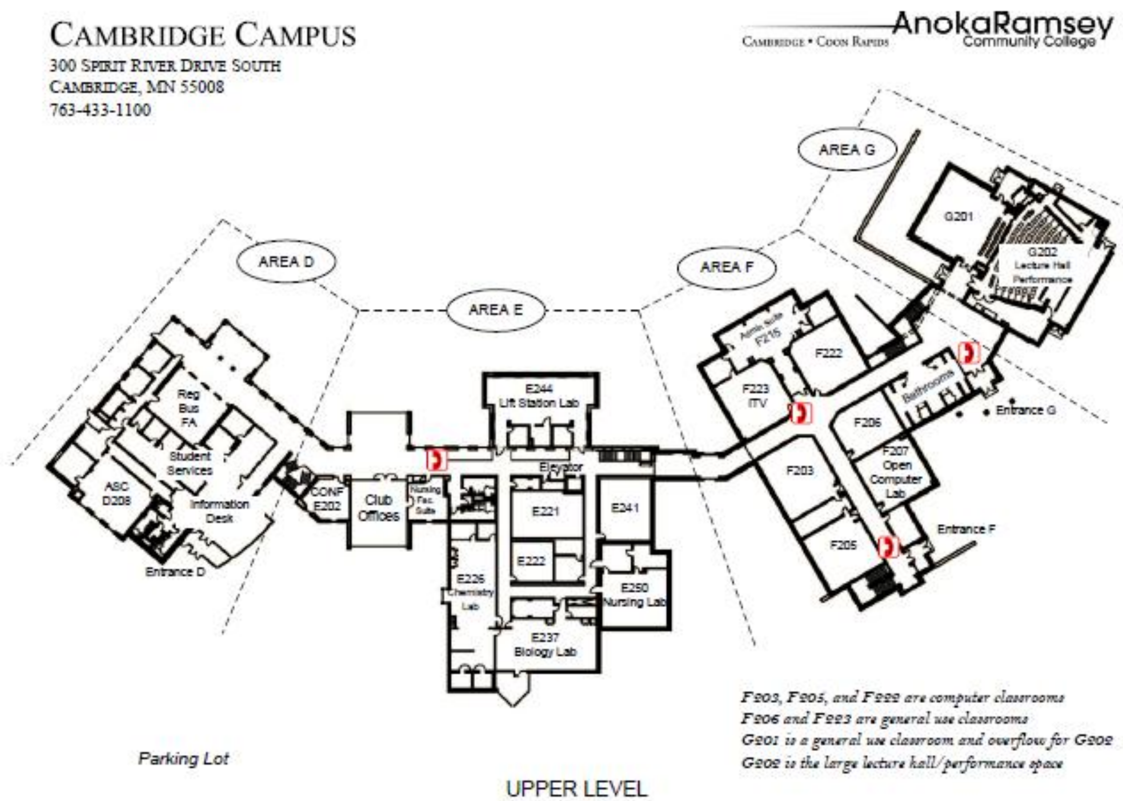
- The addition from 2007 was commissioned and tested and balanced. No commissioning or balance reports could be found for the projects from 1996 and the 2009 mechanical upgrade.

Poor Candidates for Investigation

There seven buildings listed below in the table are poor candidates for investigation. They are small in size, stated to contain no or very limited mechanical equipment and all buildings besides the garage are only used for storage. The Campus Center Garage contains radiant heat, which was installed in 2007. The other building not recommended for investigation is the Humanities Addition #2. It was stated this building is going to be demolished.

Building Name	State ID	Square Feet
Silo	E26141C1005	200
Pole Barn	E26141C0805	1,500
Garage	E26141C0905	720
Garage	E26141C0386	832
Campus Center Garage	E26141C0305	2,400
Barn	E26141C0705	1,500
Humanities Addition #2	E26141C0693	5,950

Campus Map


CAMBRIDGE CAMPUS
300 SPIRIT RIVER DRIVE SOUTH
CAMBRIDGE, MN 55008
763-433-1100
AnokaRamsey
Community College
CAMBRIDGE • COON RAPIDS
AREA D
AREA E
AREA F
AREA G
G201
G202
Lecture Hall
Performance
F222
F223
ITV
F206
Bathrooms
Entrance G
F203
F207
Open
Computer
Lab
F205
Entrance F
E244
Lift Station Lab
Elevator
E221
E241
E222
E226
Chemistry
Lab
E250
Nursing Lab
E237
Biology Lab
CONF
E202
Club
Offices
Reg
Bus
FA
Student
Services
ASC
D208
Information
Desk
Entrance D
Parking Lot
UPPER LEVEL
F203, F205, and F222 are computer classrooms
F206 and F223 are general use classrooms
G201 is a general use classroom and overflow for G202
G202 is the large lecture hall/performance space

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWRT	Hot Water Return Temperature
CDWST	Condenser Water Supply Temperature	HWST	Hot Water Supply Temperature
CFM	Cubic Feet per Minute	kW	Kilowatt
CHW	Chilled Water	kWh	Kilowatt-hour
CHWRT	Chilled Water Return Temperature	MA	Mixed Air
CHWDP	Chilled Water Differential Pressure	MA Enth	Mixed Air Enthalpy
CHWST	Chilled Water Supply Temperature	MARH	Mixed Air Relative Humidity
CRAC	Computer Room Air Conditioner	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	PTAC	Packaged Terminal Air Conditioner
DSP	Duct Static Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FPVAV	Fan Powered VAV	VAV	Variable Air Volume
FTR	Fin Tube Radiation	VFD	Variable Frequency Drive
GPM	Gallons per Minute	VIGV	Variable Inlet Guide Vanes
HD	Hot Deck		

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH